The irrigation-based agriculture of the arid West provides this Nation with a large share of many of the fresh and processed fruits and vegetables so vital to our nutritional welfare. Losses of irrigation water are a threat to the area's continued growth. USDA and State scientists seek ways to control these losses. Wn-45110

Scientists and engineers of USDA's Agricultural Research Service are concerned in conserving our limited water resources for expanding future needs. They are developing basic knowledge about soil and water relationships along with new practical methods and low-cost materials to reduce water losses.

Seepage is a major cause of loss of irrigation water--the lifeblood of agriculture in the arid West. In the 17 Western States, where some 29 million acres are under irrigation, the loss from conveyance channels alone is nearly 16 million acre feet of water a year or more than 14 billion gallons a day. This staggering water loss is largely seepage, which also severely damages lower lying lands.

Research on seepage is based at the new U. S. Water Conservation Laboratory at Tempe, Ariz. Studies in progress include the design and use of mathematical models, electrical analogs, soil columns, sand tanks, and hydraulic flumes to discover new principles and develop improved methods for evaluating seepage. Laboratory and field work on bentonite (clay with a high swelling capacity) for use in lining ditches and small reservoirs is done at Reno, Nev. Other related seepage-control studies are underway at Logan, Utah, and Columbia, Mo.

One recent major accomplishment at the Tempe laboratory is the development of a technique for more accurate measurement of seepage. Known as the variable head meter technique, it permits the measurement of the rate of water loss and aids in the determination of canal bottom materials that need sealing against seepage.

New low-cost chemical treatments under test at Tempe may provide 80 percent control of seepage at a cost of about 10 cents per square yard. This compares with a minimum cost of $1.00 per square yard for efficient conventional canal and ditch lining materials, such as plastic film, synthetic rubber sheeting, concrete, hot-mix asphalt paving, asphalt-burlap, and delayed-setting plastics.

U. S. DEPARTMENT OF AGRICULTURE
Agricultural Research Service
Soil and Water Research Division

Picture Story No. 143
June 1962

Magazines and newspapers may obtain glossy prints of these photographs in any size up to 8x10 from the Photography Division, Office of Information, U.S. Department of Agriculture, Washington 25, D. C. Others may purchase prints in any size from the same address. Prints in 8x10 size are $1.10 each.

The new treatments offer a radically new approach to the seepage problem. Some of the materials do not provide a lining in the usual sense of the word. They are placed in a canal or reservoir and move into the soil with the water to form insoluble particles that plug the soil pores below the soil surface. Other new materials, such as dispersable asphalt emulsions, may be sprayed on the soil surface to form a surface lining that has some strength.

The materials that appear most promising are those which plug the soil pores. Many substances can be used for this purpose, but they must be carefully selected and applied so that reaction is delayed until the compound has penetrated the soil. Soluble sodium soaps, for example, will react with calcium to form insoluble "curds." By using special emulsifying techniques and special sodium compounds, the reaction can be delayed so that the "curds" form after the sodium compound has penetrated into the soil.

Before new low-cost seepage control materials can be recommended for general application, they must be proved harmless to humans, crops, and animals and must pass performance tests under a wide range of soil and water conditions. The prospects are good, however, that low-cost seepage control treatments that are safe and effective may soon be widely used.

Soil scientist Myron B. Rollins samples sand from canal bottom for seepage tests at Fallon, Nev. With some exceptions, permeability increases with size of the particles of the soil. N-45201

Soil sealants are applied to the test section of this tilting flume, and the water velocity is measured at the point where the seal fails. (L to R) John Griggs, physical science technician, and Gary Frasier, agricultural engineer, conduct the tests at the U. S. Water Conservation Laboratory, Tempe, Ariz. N-44172

Water is lost from unlined canals and ditches by seepage and by water-consuming weeds, deep-rooted shrubs, and trees that grow along the banks. Water seeping into adjacent bottom lands also causes drainage problems and salt accumulations that damage the land. BN-16307X

The new treatments offer a radically new approach to the seepage problem. Some of the materials do not provide a lining in the usual sense of the word. They are placed in a canal or reservoir and move into the soil with the water to form insoluble particles that plug the soil pores below the soil surface. Other new materials, such as dispersable asphalt emulsions, may be sprayed on the soil surface to form a surface lining that has some strength.

The materials that appear most promising are those which plug the soil pores. Mnny substances can be used for this purpose, but they must be carefully selected and applied so that reaction is delayed until the compound has penetrated the soil. Soluble sodium soaps, for example, will react with calcium to form insoluble "curds." By using special emulsifying techniques and special sodium compounds, the reaction can be delayed so that the "curds" form after the sodium compound has penetrated into the soil.

Before new low-cost seepage control materials can be recommended for general application, they must be proved harmless to humans, crops, and animals and must pass performance tests under a wide range of soil and water conditions. The prospects are good, however, that low-cost seepage control treatments that are safe and effective may soon be widely used.

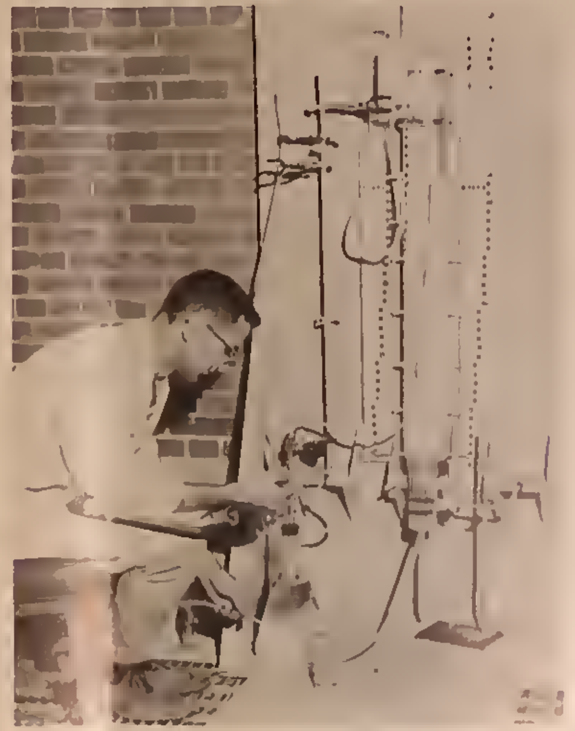
Soil scientist Myron B. Rollins samples sand from canal bottom for seepage tests at Fallon, Nev. With some exceptions, permeability increases with size of the particles of the soil. N-45201

Soil sealants are applied to the test section of this tilting flume, and the water velocity is measured at the point where the seal fails. (L to R) John Griggs, physical science technician, and Gary Frasier, agricultural engineer, conduct the tests at the U. S. Water Conservation Laboratory, Tempe, Ariz. N-44172

Water is lost from unlined canals and ditches by seepage and by water-consuming weeds, deep-rooted shrubs, and trees that grow along the banks. Water seeping into adjacent bottom lands also causes drainage problems and salt accumulations that damage the land. BN-16307X

This resistance network analog--an electrical device that simulates the flow of water in the soil--is one of the modern research tools used by Dr. Herman Bouwer at the U. S. Water Conservation Laboratory, Tempe, Ariz. N-44161

Engineer Robert Rice measures seepage from an unlined canal with the falling-head seepage meter developed at the U. S. Water Conservation laboratory, Tempe, Ariz. Changes of pressure inside and outside the cup installed in the canal bed are measured with the manometers on the bank. BN-16279



The rate at which water passes through a soil column is measured by this equipment demonstrated by USDA Engineer Robert Rice at the Tempe laboratory. N-44166

Soil scientist Myron B. Rollins (left) and Roger E. Grable, science aide, use these cylinders in laboratory determinations of sealing properties of bentonite clays at Reno, Nev. Variations in the sodium and calcium content of bentonite influence the clay's sealing effectiveness. N-45191

High-gelling property of a sample of bentonite clay is demonstrated by Myron Rollins, soil scientist at the Reno, Nev., laboratory. A 6-percent solution of the clay in the test tube does not pour. N-45196

Lining irrigation canals and laterals will drastically reduce water losses. Linings also help to control weeds and prevent drainage problems. This lateral has been lined with concrete. Concrete lining is effective and durable but high in cost. FS-491779

Plastic linings provide moderate-cost seepage control and are especially suitable for small reservoirs. This one is being installed in sections 6 x 300 ft. BN-16311X

Asphalt-burlap linings have been under test by USDA engineers for several years. Here rot-proofed jute burlap is laid over a coat of hot asphalt. This is followed by another coat of hot asphalt and finally a covering of mineral granules. BN-16306X

A slip form is used here to construct a concrete lining. This is one of the methods developed by ARS and State engineers at Logan, Utah. A new hopper design to improve the flow of concrete mortar through the slip form is now available. BN-16309X

To protect the plastic lining a fine-textured earth cover is placed over it, followed by a layer of gravel on the slopes. Only the side slopes need be covered if provision is made for 1 foot of water to remain over the bottom of reservoir at all times. BN-16308X

This canal is lined with asphalt-coated jute. Ends of the liner are buried in trench paralleling the ditch to hold the liner in place. If good concrete aggregate is not available locally and foundation soils are unstable, asphalt liners will be more economical than concrete. BN-16310X

Methods of lining irrigation canals tested and developed by USDA soil and water engineers are now widely used. This irrigation ditch on a sugar plantation in Hawaii is being lined with buried asphalt membrane. TH-439

A seepage-reducing chemical is applied to a ponded irrigation canal in a full-scale field trial. This is one of the promising new low-cost materials being tested at the Tempe, Ariz., laboratory. Such chemical materials may be effective where extensive erosion does not occur. BN-16280